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CAMBODIA, LAOS, THAILAND AND VIET-NAM

Committee for Coordination of Investigations
of the Lower Mekong Basin.
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SUMMARY REVIEW OF "COMPREHENSIVE RECONNAISSANCE REPORT ON THE MAJOR TRIBUTARIES OF THE LOWER MEKONG BASIN"

Note prepared by the secretariat

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I. DEVELOPMENT OF THE MAJOR TRIBUTARIES

The work on the reconnaissance of major tributaries in the lower Mekong basin, carried out by a team of experts organized by the Government of Japan, was started in January 1959 and completed in September 1961 over a period of two years and nine months. Altogether 35 experts participated in reconnaissance surveys involving about 75 man-month of field work. In addition, 8 more experts were assigned to assist the team in Tokyo in the analysis of data and planning of projects. The total sum allocated to the reconnaissance survey by the Government of Japan amounted to 97 million yen or $270,000 equivalent.

In addition to three interim reports presented to the Coordination Committee previously, the team submitted a 437 page final or comprehensive report[1/] to the Committee at its 15th session in October 1961. The secretariat was requested by the Committee to prepare a summary review of the report for use by the Committee at its 16th session.

Ground survey conducted by the Reconnaissance Team in the field covered practically all major tributaries of the lower basin, totalling 30 in number, from the delta up to Pa Mong. In addition to these 30 major tributaries, the Team also included in its report 4 more tributaries located between Pa Mong and Luang Prabang over which aerial inspection was made. The 34 tributaries included in the report comprise approximately 62 per cent of the drainage area of the lower Mekong basin, or 389,570 square kilometres out of 635,000 square kilometres.

As a result of the first field survey in 1959 covering 34 tributaries, the Team singled out 16 tributaries as the more promising ones and recommended

/for early

1/ "Comprehensive Reconnaissance Report on the Major Tributaries of the Lower Mekong Basin" prepared by the Mekong Reconnaissance Team organized by the Government of Japan, Tokyo, September 1961, 347 pages plus 31 tables and 59 maps and figures.

for early development. Out of these 16 tributaries, the Committee selected 4, namely: the Stung Battambang (Cambodia), Nam Ngum (Laos), Nam Pong (Thailand), and Upper Se San (Viet-Nam) and obtained assistance from the United Nations Special Fund to carry out detailed investigations which would culminate in four comprehensive project reports suitable for negotiation of loans for construction. The Government of Japan also provided assistance in the preparation of comprehensive reports for two more tributaries, namely the Prek Thhnot (Cambodia) and Nam Gam (Thailand), and was requested by the Committee to also include the Upper Srepok (Viet-Nam) on which a hydrologic station is being established by the Team and measurements will be taken. For the Prek Thhnot project, the planning of irrigation development was promised by the Government of Israel.

Given in table 1 is a summary of the 34 tributaries investigated by the Team, the 16 promising ones recommended for early development, and the 7 already under detailed investigation[1/].

/Table 1

1/ Including the Upper Srepok

Table 1

Tributaries covered by the reconnaissance surveys

(Please refer to general map of the lower Mekong basin contained in the envelope on back of the Comprehensive Reconnaissance Report)

No.	Major tributaries		Drainage area sq km	Promising tributaries	Tributaries recommended for detailed investigation	
	34 tributaries covered by 1st survey	Method of survey		16 tributaries covered by 2nd and 3rd surveys	8 tributaries recommended by Japanese Team	Action taken by the Committee
	LAOS					
1	Nam Ou	A	25,600			
2	Nam Seng	A	6,780			
3	Nam Khan	A	7,410			
4	Nam Ngum	AG	16,000	(a) Nam Ngum (b) Nam Lik	Nam Ngum	Special Fund Project
4X	(Nam Nhiep)	A	(3,600)			
4Y	(Nam Sane)	A	(2,100)			
5	Nam Theun	AG	14,700	Nam Theun	Nam Theun	No action
6	Se Bang Fai	AG	9,550	Se Bang Fai		
7	Se Bang Hieng	AG	19,800	Se Bang Hieng		
8	Se Done	AG	7,790	Se Done		
	LAOS-THAILAND					
9	Nam Hieng	A	4,360			
	THAILAND					
10	Nam Gam	AG	3,440	Nam Gam	Nam Gam	Japanese Aid Project
11	Nam Mune & Chee	AG	117,000	(a) Lam Dom Noi (b) Chaya Poum		
12	Nam Pong	AG	(15,900)	Nam Pong	Nam Pong	Special Fund Project
13	Nam Pao	AG	(7,600)			
14	Nam Song Gram	AG	10,800			
15	Huey Bang Sai	AG	1,350			
16	Nam Mong	AG	2,390			
	CAMBODIA-LAOS					
17	Se Kong	AG	25,600			

A = Aerial inspection

G = Ground inspection

No.	Major tributaries: 34 tributaries covered by 1st survey	Method of survey	Drainage area sq km	Promising tributaries: 16 tributaries covered by 2nd and 3rd surveys	Tributaries recommended for detailed investigation: 8 tributaries recommended by Japanese Team	Action taken by the Committee
	CAMBODIA-VIETNAM					
18	Se San	AG	18,000	Upper Se San	Upper Se San (8,300)	Special Fund Project
19	Srepok	AG	30,800	Upper Srepok	Upper Srepok (7,800)	Japanese Aid Project (Hydrology only)
	CAMBODIA					
20	Prek Te	AG	4,350			
21	Prek Chhlong	AG	5,660			
22	Prek Mak Kompul	-	-			
23	Tonle Tooh	AG	-			
24	Prek Kompong Trabek	AG	-			
25	Prek Thhnot	AG	5,050	Prek Thhnot	Prek Thhnot	Japanese and Israeli Aid Project
26	Stung Pursat	AG	5,100	Stung Pursat		
27	Stung Moung (Daun Tri)	AG	4,050			
28	Stung Battambang	AG	4,520	Stung Battambang	Stung Battambang	Special Fund Project
29	Stung Mongkol Borey	AG	4,330			
30	Stung Sreng	AG	6,270			
31	Stung Siem Reap	AG	860			
32	Stung Staung	AG	3,390			
33	Stung Sen	AG	17,800	Stung Sen		
34	Stung Chinit	AG	6,820			
Total of 34 tributaries			389,570			
Total area of lower basin			635,000			
% of lower basin			62%			

A = Aerial inspection
G = Ground inspection

Regarding action to be taken on the remaining 9 of the more promising tributaries, the Team recommended that hydrologic stations be established at the respective likely dam sites and topographic maps be prepared for the reservoir and irrigable areas. Such basic engineering data are indispensable for carrying out detailed investigation or project planning. In addition, the Team also recommended that the Nam Theun be taken up for detailed investigation (including preparation of a comprehensive project report). The work involved and cost estimates for these 9 tributaries (as well as some work for the 3 tributaries taken up by Japan and Israel) are listed separately in tables 2, 3 and 4. On the average, the cost of basic data collection (hydrology and topography) is estimated at about $50,000 to $60,000 per tributary project, and the cost of detailed investigation including preparation of a comprehensive project report for one tributary project is around $300,000 to $400,000.

Table 2

Basic data required for detailed investigation of 12 promising projects (16 projects less 4 undertaken by Special Fund) as recommended by the Japanese Team

No.	Promising tributaries	Location	Number of hydrologic stations required[a]	Number of rain and evaporation gauges			Topographic mapping sq km
				Recording intensity gauge	Ordinary rain gauge	Evaporation pans	
4	Nam Lik	Laos	1	1		1	400
5	Nam Theun	Laos	1	1		1	2,000
6	Se Bang Fai	Laos	1	1		1	1,000
7	Se Bang Hieng	Laos	1	1		1	1,500
8	Se Done	Laos	1	1		1	500
10	Nam Gam	Thailand	[c]				[e]
11 (a)	Lam Dom Noi	Thailand	1	1		1	600
(b)	Chaya Poum	Thailand	[b]				[d]
19	Upper Srepok	Viet-Nam	[c]				[d]
25	Prek Thhnot	Cambodia	[c]				1,400
26	Stung Pursat	Cambodia	1	1		1	600
33	Stung Sen	Cambodia	1	1		1	7,000
	Total		8	24	(70)	24	15,000 km^2
	Estimated costs						

a/ In addition to stations already established by Harza Company under US aid programme
b/ Station already established by the Royal Irrigation Department
c/ Station already established under Japanese aid
d/ Map to be supplied under Canadian aid
e/ Map to be supplied under Japanese aid.

Table 3

Cost estimate of basic data collection for 12 promising projects as recommended by the Japanese Team

No.	Tributaries	Location	Mapping	Hydrology installation	3 years operation	Total
4	Nam Lik	Laos	8,000	23,625	21,000	52,625
5	Nam Theun	Laos	40,000	23,625	21,000	84,625
6	Se Bang Fai	Laos	20,000	23,625	21,000	64,625
7	Se Bang Hieng	Laos	30,000	23,625	21,000	74,625
8	Se Done	Laos	10,000	23,625	21,000	54,625
10	Nam Gam	Thailand	c/	23,625	21,000	44,625
11	(a) Lam Dom Noi	Thailand	12,000	23,625	21,000	56,625
	(b) Chaya Poum	Thailand	d/	b/	b/	-
19	Upper Srepok	Viet-Nam	d/	a/	21,000	21,000
25	Prek Thhnot	Cambodia	28,000	a/	21,000	49,000
26	Stung Pursat	Cambodia	12,000	a/	21,000	33,000
33	Stung Sen	Cambodia	14,000 e/	23,625	21,000	58,625
			300,000	189,000	231,000	720,000

Table 4

Estimated cost for detailed investigation and preparation of comprehensive report for the Nam Theun Project (Number 5) as recommended by the Japanese Team

1. Field investigation including geological boring	150,000
2. Preliminary design and report	150,000
Total	$300,000

a/ Provided under Japanese aid
b/ Installed and operated by Royal Irrigation Department
c/ Provided under Japanese aid
d/ Provided under Canadian programme
e/ Reservoir and irrigable area of Stung Sen only

The secretariat fully concurs with the recommendation of the Japanese Team that collection of basic data for the promising tributaries be initiated without delay. On some of these promising tributaries, stream gauging stations have already been established under the U.S. aid programme. Such stations, however, are not located at the proposed project (dam) sites but in the vicinity of the confluence of tributaries with the Mekong, and were established with a view to ascertaining the water potential of the tributaries in the entire lower basin. It is definitely not advisable to shift any of these stream gauging stations before years of continuous records become available. The secretariat is of the opinion that, with regard to the establishment of new stations, the Committee may seek assistance from cooperating countries for the supply of necessary equipment of an estimated cost of about $200,000. The riparian countries concerned would be responsible for maintenance and operation.

It may be noted that topographic maps on a scale ranging from 1:10,000 to 50,000 of the promising tributaries were compiled by the Japanese Team from aerial photographs made available to them (see list on page AP-II-22 to 24 of the Comprehensive Report). However, most of these maps on a scale of 1:10,000 do not cover the entire project area but only the dam sites. A few maps covering the entire reservoir project area are on a scale of 1:50,000 and are not sufficiently detailed for project planning. Moreover, the lack of ground control in the preparation of the maps also affect the desired accuracy. Therefore, the preparation of topographic maps on a scale of 1:20,000 for the reservoir and irrigable areas, and maps of 1:2,000 for dams and other structure sites, are necessary. As the aerial photographs of the areas under consideration are already available with the national agencies, it is hoped that mapping can be included in the respective national programmes.

/The Japanese

The Japanese Team further recommended that among these 9 promising tributaries, detailed investigation be carried out for the Nam Theun scheme. The Report indicated that the development of the Nam Theun would include seven projects on the Nam Theun proper and on its tributaries and also the diversion of flow into neighbouring streams. The secretariat feels that, before going into project planning of such a major system involving 1.7 million kilowatts of maximum power, it would be highly desirable to embark on a programme of systematic measurement of available water at every key project site and to defer project planning until several years continuous hydrologic data become available. The Japanese Team may be requested to prepare a detailed programme for the establishment of a network of hydrologic and meteorological stations and of measurements for the Nam Theun basin. The establishment of only one station in the entire project area, as recommended in the Report, may not be sufficient to serve the purpose of planning such a complicated system.

/II. DEVELOPMENT

II. DEVELOPMENT OF THE MAIN STEM

The objective of the reconnaissance survey, very competently undertaken by the team of experts organized by the Government of Japan, was to ascertain the potentialities of water resources development of the major tributaries in the Lower Mekong Basin. As the development of many of the major tributaries is intimately related to the development of main stem (for example the Nam Pong and Nam Mong projects would receive their flow from the Pa Mong reservoir), the Team also looked into related development in the main river. In fact, the development of the Mekong is such a challenging task to engineers with imagination that any one dealing with a part of it cannot lose sight of its tremendous possibilities in its entirety. The Team has in fact devoted considerable effort to the study of main stem projects which are only remotely related to the tributaries.

In its comprehensive report, the Team presented a revised scheme on the development of the main stem of the river.[1/] This revised scheme differs essentially from the one contained in ECAFE report[2/] in that two large storage projects are added to the system, namely: the Pak Beng project located 120 km upstream of Luang Prabang, with an effective storage of 20 billion m^3, and the Stung Treng project located just downstream of Stung Treng with an effective storage of 31 billion m^3. The Pa Mong dam, as suggested in the first reconnaissance report, would have its height increased from 40 to 80 metres to provide an effective storage of 38 billion m^3. The general layout of the revised scheme is shown in figure 1.

/With only

1/ See Chapter V of the Comprehensive Report, in particular table 21 facing page V-16 and figures V-F-1 and V-F-2

2/ ECAFE: Flood Control Series No. 12 "Development of Water Resources in the Lower Mekong Basin", 1957

With only the Pa Mong and the Stung Treng projects on the main stem and a few tributary storage projects in Laos located between Vientiane and Khemarat, which together would have a total effective storage of 85 billion m^3, it would be possible, according to the report, to keep the flood flow at Phnom-Penh to below 20,000 m^3/sec (water level 8.00) at all times and to maintain low water flow above 5,100 m^3/sec (water level 3.7 m). By diverting the flow from Stung Treng reservoir to the Stung Sen and subsequently to the Stung Staung, Stung Chkreng and Stung Sreng, over a million hectares of land north of the Great Lake could be brought under irrigation.

The proposals summarized above and related studies[1/] contained in the Report are studies related to "River Basin Planning". In fact, the "Five-Year Programme of Studies and Investigation", recommended by the Wheeler Mission and approved by the Committee calls for the preparation of a skeleton basin plan in the fifth year of operation after essential basic data (hydrology, geology, mapping, etc.) are available. Canada has undertaken to have all main stem topographic maps ready by the end of April 1962. The Harza Engineering Co. will soon complete the processing of hydrological data for all stations in the lower basin for the years 1959 and 1960 and will also be ready with compilation and analysis of past records taken before 1959. With these data available, to be supplemented by other investigations such as detailed mapping of sites, geological investigations, construction material surveys, and other agricultural and economic investigations, it should be possible to assess with certainty the desirable size of the projects and their optimum combination together with an estimate of costs and benefits. The detailed investigations being carried out or to be carried out at Pa Mong, Sambor and Tonle Sap will greatly facilitate the work towards the preparation of

/a basin plan.

1/ See Comprehensive Report, Chapter V - Suggestions on main stream projects; Chapter VII - General review of the development of the Mekong basin water resources, and Appendix IIIA - Study of after effects of development of the main stem and tributary project on the delta region.

a basin plan.

The Japanese Team has, with unequalled vision, presented in its report the possibilities of the development of projects on the main stem. However, it is not possible at present to pass any definite opinion on the proposals without first attempting to secure more hydrologic data, accurate topographic maps and other information. Suffice it to say is that the proposals definitely deserve very intensive further investigation, and provide very useful guidance for the preparation of a comprehensive plan for the entire lower Mekong basin.

The Committee has already embarked upon a programme of detailed investigation of three of the main stem projects, namely the Pa Mong, Sambor and Tonle Sap, under the main responsibility of respectively USA, Japan and India; and with considerable collateral support from inter alia Australia, France, New Zealand, UNESCO, and the UN Special Fund. One is often questioned as to the wisdom of having launched a programme of detailed investigation of certain projects without having first worked out a comprehensive basin plan.

A river basin is an integral organic unit and all projects in a basin will affect each other. One of the main objectives of a river basin plan is to coordinate the planning of all individual projects in such a way that the combined system will yield optimum benefits at the lowest cost for the largest number of people. This is normally done by comparison with other alternative projects and combinations. Theoretically, it is desirable to select a project for detailed investigation only after its exact position as related to other projects in a basin plan is quite well known. But in practice, the time and cost involved in the preparation of a basin plan make it impractical to wait for its completion before embarking on planning and investigation of single projects. On the other hand, one should not embark on the planning of any single project, if it is so

/obviously known

obviously known that development of such a project would preclude the possible development of better projects or would adversely affect the optimum development of the system as a whole. Very often a preliminary basin plan, giving a general orientation of the relation of projects with each other and with the basin as a whole, will meet the practical requirement. The question of how much ground a preliminary plan should cover is a matter of judgement. In an developing country, it is often imperative to initiate a development project, without an overall plan, provided that, after careful consideration of all known factors then existing, it may be concluded that such a development project would not adversely affect others.

Any basin plan, no matter how comprehensive it may be, is always subject to alterations and revision, as new data become available, new needs arise and new techniques develop. In 1957, on the basis of a preliminary plan prepared by ECAFE, the Committee assigned first priority to the detailed investigation of three main stem projects, namely Pa Mong, Sambor and Tonle Sap, and arrangements were made with cooperating countries to proceed with the investigations. In the light of the recent proposals contained in the Japanese Report covering main stem projects, the Committee may wish, no matter how preliminary the proposals are, to examine whether any adjustment of its programme of investigations would be desirable.

The Pa Mong dam is located at the exit of a gorge, below which the Mekong flows in an open valley for more than 350 km before it enters another gorge, the Khemarat. The Pa Mong is therefore a natural site for a storage dam that will not be affected by projects located downstream. The size of the Pa Mong project, or the height of the dam, will affect the location and size of the next project immediately upstream, somewhere between Pak Lay and Luang Prabang, but it will not,

/as far as

as far as the present knowledge of the area indicates, in any way have repercussions on other projects, and it will in no way obstruct other possibilities of superior development. Therefore, the secretariat believes there is no reason to hold up detailed investigation of the Pa Mong.

The Sambor project is the power dam located furthest downstream on the main river. The topographic maps of the dam site provided by Canada and supplemented by the Service Geographique Khmer show that it is not economically feasible to raise the present water level of 6 metres above MSL by means of a dam to more than 35 to 40 metres above MSL, as the embankments on the gentle sloping land on both banks would be too high and would have to be extended over too great a distance to reach higher ground. At this elevation of 40 metres above MSL, the backwaters can reach only below Stung Treng. Between Sambor and Stung Treng, there is no other choice than a low dam at Sambor with a limited height. From Stung Treng upstream, there are various alternatives of development such as (1) a series of low dams heading the flow to the foot of Khone Falls, (2) one medium size dam to head the flow to the foot of Khone Falls or (3) a high dam to submerge the Khone Falls. To develop this reach between Stung Treng and Khone, it will be necessary to investigate the various alternatives and possibilities which are certainly not limited to any one single combination.

As far as the Sambor site is concerned, physical conditions limit the choice of the site and restrict the dam height to below 35 or 40 metres above MSL. The river flow available for power generation as well as the maximum flood are the only variables that are dependent on the degree of regulation of flow by projects located upstream, which can be estimated and taken into account in planning. There is therefore no reason for holding up the detailed investigation of the Sambor project until a basin plan is available.

/The Tonle Sap

The Tonle Sap project was planned for moderation of flood flow in the delta. It may be argued that if the major main stem projects, notably the Pa Mong and Stung Treng, could provide sufficient storage to moderate the flood flow, it would not be necessary to have the Tonle Sap project at all. Thus it would follow that detailed investigation of Tonle Sap may be postponed until comparative studies of these alternative schemes are ready. This argument applies also to the delta model study to be started by UNESCO with Special Fund finance.

The Pa Mong project, located 900 km away from the delta, cannot replace the flood control function of the Great Lake, whenever flood producing typhoons cross the Indo-chinese peninsular downstream of Pa Mong, as is frequently the case. On the other hand, the Stung Treng reservoir, located near the head of the delta, appears to be in a position to compete with Tonle Sap for controlling the flood in the delta. A comparison of the two schemes, Stung Treng and Tonle Sap, would have to be based on their costs and benefits after checking the engineering feasibility. The lack of data does not permit any rough comparison to be made at present. On the basis of experience of flood control both inside and outside the region, it is quite evident that the detention of flood waters by means of an existing lake generally offers the cheapest means of flood control, as evidenced by the fact that a simple barrage at Tonle Sap, with a draw-down of 4 to 5 metres, would provide about 30 billion m^3 storage in the Lake, a volume comparable to the life storage of Stung Treng and Pa Mong. Even should further studies show that the Stung Treng reservoir could provide flood control in the delta at a cost less than that of the Tonle Sap project, the Tonle Sap can always serve the useful purpose of maintaining sufficient depth of water in the Lake for fish

/production.

production. It can further regulate the run-off from tributaries of the Great Lake into the Mekong[1/]. For this reason, the secretariat believes that detailed investigation of the Tonle Sap project should not be held up pendin further studies on the Stung Treng.

When examining the programme of studies and investigation as a whole, the secretariat concludes that detailed investigation of the three priority projects should be carried forward without delay. Concurrently with the programme of detailed investigation, work on the preparation of a skeleton plan for the entire lower basin should be initiated. Whereas a basin plan is an indispensable instrument in coordinating individual projects for optimum development of water resources in the basin, the detailed investigation of individual projects in turn provides the basic studies and analyses on the basis of which a proper basin plan is to be formulated. The secretariat plans to revise the preliminary plan prepared in 1957, as soon as the basic data become available, with a view to gradually developing it into a comprehensive plan, concurrently with the progress of the detailed investigation of the main river and tributaries projects undertaken by national agencies and cooperating countries.

/III. SECRETARIAT

1/ See footnote 1 on page III-A-18 of the Comprehensive Report

III. SECRETARIAT RECOMMENDATIONS

In the light of the above consideration, the secretariat makes the following recommendations:-

1. The Japanese Team of Experts, under the leadership of Mr. Y. Kubota, has completed in less than three years an excellent piece of work in the reconnaissance of the major tributaries. The Report prepared by the Team provides for the first time a comprehensive outline of the potentialities and opportunities of development of the tributaries, which are of vital importance for the development of the Lower Basin. The Committee may wish to record its deep appreciation of the work of the Team and thank the Government and people of Japan for this exceedingly valuable assistance given to the Committee in furthering the Mekong project.

2. Of the 16 promising tributaries[1/] recommended by the Team, 7 tributaries are currently under planning. It is recommended that collection of basic data be initiated for the remaining 9 tributaries. The work includes the establishment and operation (3 years) of hydrologic stations at an estimated cost of $420,000, and topographic mapping at an estimated cost of $300,000. The Committee may wish to seek outside assistance for the procurement of hydrologic equipment estimated at about $200,000, and to include the rest of the work under their own national programmes.

3. To prepare for the planning of a system of projects in the Nam Theun basin, the Japanese Team might be requested to prepare for the Committee a detailed plan for the establishment of hydrological and meteorological stations and topographic mapping.

/4. As much

1/ See tables 2, 3 and 4

4. As much further basic data on the basin will soon become available, e.g. topographic maps and hydrologic observations, it is recommended that the secretariat be authorized to proceed with the preparation of the basin plan. The secretariat may also be authorized to negotiate for assistance required both to secure additional data (such as detailed mapping) and to carry out necessary investigations (such as dam foundation investigations).

5. There should be no slackening of effort in planning and in the preparation of comprehensive project reports on the three main stem projects viz Pa mong, Sambor and Tonle Sap.

6. With a view to facilitating basin planning, it is recommended that riparian countries give highest priority in their national mapping programmes to these areas covered by projects, both on the Mekong main stem and on the tributaries.

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Committee for Coordination of Investigations
of the Lower Mekong Basin,
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INDEX OF TOPOGRAPHIC MAPS OF THE LOWER MEKONG BASIN AS OF 1 JANUARY 1961

Information paper prepared by the secretariat

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I. INTRODUCTORY EXPLANATION

1. Of all the basic data required for reconnaissance, planning, design and operation of water projects, it can be said without doubt that topographic mapping stands very high in the list of requirement. In its programme of studies and investigations, the Committee had accorded high priority to topographic mapping and had obtained the assistance of Canada in mapping the entire main river and several dam sites and many tributaries. The Japanese Reconnaissance Team had prepared a number of topographic maps for conducting field work and for planning tributary projects. The riparian countries, under their own mapping programme and under bi-lateral and other aid programme, are preparing topographic maps for general use and for various projects. In the Special Fund/UNESCO delta model project, it will be necessary to map the Great Lake and the deltaic area. The Special Fund hydrography survey is going to carry out systematic mapping of the river channel.

2. To facilitate the development of the Mekong, it is of interest to compile an index showing the current mapping available in the lower Mekong basin. Such an index should naturally include not only those maps prepared specifically for the Committee, but also maps carried out by the respective countries under their own programme. The country maps are often prepared in a smaller scale, but they provide the basis for carrying out reconnaissance work and for planning development projects over a larger area.

3. The present index lists only those topographic maps which are considered to be most useful to planners and not all of the maps published by the national agencies. It is requested that this index be examined and checked by the national agencies and will then be revised to reflect the correct situation of mapping in the lower Mekong basin.

/4. A list

4. A list of maps, old and new, published by the mapping agencies in the respective countries are attached as annexes in this paper.

5. Maps other than topographic maps are also useful in planning water resources development, such as hydrographic maps, geological maps, soil maps, mineral maps, and maps of land use. It is the intention of the secretariat to publish in the near future an index of other related maps.

/II. INDEX MAP

II. INDEX MAP ON LEVELLING

(Figure 1)

The datum plane of the network of levelling in Thailand is the observed mean sea level at Ko Lok, Prachuab Kirikhan, located on the western coast of the Gulf of Thailand. The datum plane of the network of levelling in Cambodia, Laos and Viet-Nam is the observed mean sea level at Mui Nai, Ha-Tien, on the eastern coast of the Gulf.

Under the US aid programme to the Committee, a line of 3rd order levelling has been established along the main stem of the Mekong from the Burma-Thai-Laos border at Chieng Saen to Kompong Cham in Cambodia, and from the main stem to several gauging stations in the major tributaries. This line of levelling is connected with ties to the Thai levelling network. Under the same programme, first order check levelling has been carried out in the deltaic area along the following existing lines: Kompong Cham to Phnom-Penh; Battambang to Phnom-Penh; Phnom-Penh to Ha Tien; and Ha Tien to Cantho Soctrang. Cards of the individual bench marks covered by the US programme, carried out by a group of Canadian firms, are presently kept by the Harza Engineering Co. and will be turned over to the Committee.

A profile of the Mekong main stem from the Burma border to Phnom-Penh, showing water level of the main river reduced to 1 April 1960, has been prepared by the Hunting Survey Co. of Canada. For the lack of levelling, profiles of the major tributaries of the Mekong are not yet available.

Figure 1 shows the existing network of levelling in the lower Mekong basin.

/III. INDEX OF

III. INDEX OF AERIAL PHOTOGRAPHIC COVERAGE
(Figure 2)

The lower Mekong basin is completely covered with aerial photographs, carried out by the national agencies with the assistance of Army Map Service of USA. The photographs, taken in the period from 1953 to 1957, are at a scale of 1:40,000 and in a format of 25 x 25 cm.

Another set of aerial photographs, taken by Institute Geographique National in 1952-1954, covers Laos, Cambodia and Viet-Nam. The scale is 1:40,000 and the format is 13 x 18 cm.

Large scale photographs, at a scale of 1:10,000 are available for part of the area around the Great Lake in Cambodia.

Photographs at a scale of 1:40,000 of the main stem of the Mekong from Burma border to Phnom-Penh and of several major tributaries were taken by Canada in 1959. Photographs at a scale of 1:10,000 for three main stem dam sites, namely Pa Mong, Khone and Sambor were also taken by Canada.

Figure 2 is an index map of aerial photographic coverage in the lower basin.

/IV. INDEX OF

IV. INDEX OF TOPOGRAPHIC MAPS

It is not the intention to list in this paper indices of all topographic maps published by national and other agencies, but rather to list those maps of recent edition which are considered more useful in planning water resources development.

1. 1:250,000 topographic maps, contour interval 50 m (figure 3):

The most useful series of maps for general use is the 1:250,000 maps prepared by the Army Map Service, Corps of Engineers, USA, in 1954-1957 from existing topographic maps of the riparian countries. This series, printed in colours, covers the entire lower basin with 50 m contour intervals and supplementary contours at 25 m intervals. Names and explanations in the maps are given in English and French. The index of individual sheets is shown in figure 3.

2. 1:100,000 topographic maps of Cambodia, Laos and Viet-Nam, contour interval 25 m (Figure 4)

This is a series of maps prepared by the former Service Geographique de l'Indochine. It is produced by planimetric method and covers most of the area in the three countries. The contour interval is 25 m with spot levelling indicated on the maps. Index of sheets is shown in figure 4. Individual sheet is available with the mapping service of the respective countries.

3. 1:50,000 topographic maps of the lower Mekong basin, contour interval 20 m with intermediate contour at 10 m interval (figure 5)

During the past few years, the four riparian countries have obtained the assistance of Army Map Service of US Army in the preparation of a new set of 1:50,000 topographic maps. Aerial photographs, at a scale of 1:40,000, covers the entire lower basin and ground control has been completed for Thailand and Cambodia and also partly for Viet-Nam. Up to the present,

/topographic maps

topographic maps have been published for practically all of the northeastern part of Thailand. The first few sheets of maps for Cambodia are now ready and the rest for Cambodia is scheduled to be completed by the end of 1963. Production of maps for some part of Viet-Nam has begun.

This new series of 1:50,000 maps will be the most accurate and up-to-date topographic map of the lower basin. The maps are printed in colours and are available from the mapping agencies of the respective countries.

Index of the 1:50,000 maps so far completed is shown in figure 5.

As for Thailand, this new series supersedes the former 1:50,000 Thai topographic maps published by the Royal Thai Survey Department.

4. 1:20,000 main stem topographic maps of the Mekong, 5 m contour interval with intermediate contour at 2.5 m (figure 6)

The topographic mapping of the Mekong river carried out under the Canadian aid programme, covers the entire river course of the main stem from Burma border to Kompong Cham. The maps are to be produced at a scale of 1:20,000 with 5 m contour interval and intermediate contour at 2.5 m, from photographs at a scale of 1:40,000. The main stem mapping extends to both sides of the main river to include all anticipated reservoir area of the future dam-reservoir projects. Ground control covers the entire main river, while some of mapping that extend into tributaries are controlled by Air-borne Profile Recorders (APR).

Detailed topographic maps are to be provided for three dam sites, the Pa Mong, Khone, and Sambor, at a scale of 1:2,000 with contour interval of 1 m from photograph of 1:10,000.

Topographic maps will also be provided for the several tributary projects. The tributary mapping, covering the reservoir area as well as irrigable area, is at a scale of 1:20,000 with 5 m form lines from 1:40,000 aerial photographs with APR control. In addition, semi-control mossaics are to be provided for the

/irrigable area

irrigable area of four tributary projects.

An index showing the general coverage of the Canadian maps is shown in figure 6. Index showing the sheets of maps will be issued later.

5. Topographic maps by Japanese Team (Figure 7)

To facilitate their reconnaissance work, the Japanese Team, using AMS 1:40,000 aerial photographs, prepared certain amount of topographic maps of promising tributaries and feasible dam sites. The team did not carry out any ground control work, but used the ground levels as indicated in the topographic maps of the respective countries.

An index[1/] of all maps prepared by the team is shown in figure 7. In general, maps covering a larger area are at a scale of 1:50,000, with a few at a scale of 1:20,000. Maps of the dam sites are at a scale of 1:10,000.

6. 1:25,000 topographic maps of the Mekong delta in Viet-Nam and other maps (figure 7)

A major portion of the Mekong delta in Viet-Nam is covered by maps at a scale of 1:25,000 with 1 m contour interval for altitude below 15 m MSL and 5 m contour interval for altitude above 15 m MSL. Spot levellings are also indicated on the map. The area covered by this series of maps is shown in figure 7.

Topographic map at a scale of 1:25,000 is available for the area around Upper Se San in Viet-Nam. A set of maps covering the upper basin of the Nam Theun, Laos, at a scale of 1:20,000 and contour interval of 10 m was published by Institute Geographique National in Paris, in cooperation with a UN mission. The coverage of these maps is shown in figure 7.

/Annex 1

1/ Please see list of tributaries mapped by the Team as contained in the "Comprehensive Reconnaissance Report on the Major Tributaries of the Lower Mekong Basin", September 1961, page AP-II-22 to 24.

Annex 1

Catalogue des Cartes
Service Géographique Khmer des F.A.R.K., Cambodge

Echelle	Désignation des chartes et Description sommaire
1/500,000	Cartes administratives
1/400,000	Cartes routières
1/250,000	Cartes routières
1/100,000	Cartes d'Etat-Major
1/50,000	Cartes sont en cours d'etablissement par l'U.S. Army Map Service Far East à Tokyo.

Annex 2
Catalogue des Cartes
Service Geographique National, Laos

Echelle	Désignation des chartes et Description sommaire
1/500,000	Carte administratives
1/400,000	Carte routières
1/250,000	Carte routières
1/100,000	Carte avec courbes de Niveau ou cartes de reconnaissance publiées sous forme d'esquisse planimétrique. Edition normal et provisoire.
1/50,000	AMS couvrant la frontière Thailande-Laos avec courbes de niveau.
1/20,000	Chutes de la Se Set (Saravane)
1/20,000	Vallée de la Nam Theun

/Annex 3

Annex 3
List of maps
Royal Survey Department, Thailand

Scale	Description
1/2,000,000	"Maps of Thailand" printed in both Thai and Roman letterings in colours. One set consists of 3 sheets.
1/1,000,000	Maps on scale 1:1,000,000 are published in two series, one called "The International 1/Million Map", the other called, "The Special 1/Million Map". The International 1/Million Map is printed in both Thai and Roman letterings in accordance with the regulations of the International One Millionth Map of the World. These maps are in colours and one set consists of 6 sheets covering all over Thailand. The Special 1/Million Map is printed in Thai lettering only, and in colours.
1/500,000	Originally maps on this scale were all printed in black but afterwards printing has been changed to 4 - colour process.
1/200,000	Maps on this scale cover the whole of Thailand but most of them are still rough maps because surveys have not yet been completed all over Thailand. Revisions are constantly made according to the surveyed details. At present there are both black and coloured editions with and without geographic coordinate reference lines. These maps in future will always be printed in 4 colours and always with geographic coordinate reference lines.
1/100,000	Maps on this scale are compiled from topographic maps of surveyed areas and therefore do not cover

/the whole

Scale	Description
	the whole country because surveys have not yet been completed all over Thailand. At present these maps are available both in black and in colours without grid. In future they will be printed in 4 colours and gridded.
1/50,000 (old series)	Maps on this scale are the standard series covering such areas as have been surveyed. At present both black and colour editions are available and un-gridded. Future maps of this series will be printed always in 4 colours and gridded.
1/50,000 (new series)	Maps are prepared with the assistance from MAS, based on aerial photographs on scale 1:40,000 and ground control carried out 1953-57. Contour interval 20 metres with intermediate contour 10 metres. Maps for part of Thailand completed.
1/25,000	Maps on this scale are printed in small number and only in black for use in constructing maps on scale 1:50,000 and are not available for sale.

Annex 4
Catalogue des Cartes
Service Géographique National, Viet-Nam

Echelle	Désignation des Cartes et Description sommaire
	VIET-NAM - CARTES GENERALES
1/25,000	CARTES AVEC COURBES DE NIVEAU établies daaprès des levés réguliers sur terrain ou CARTES DE RECONNAISSANCE éditées sous forme d'esquisse planimétriques: EDITION PROVISOIRE de 2 à 5 couleurs.
1/100,000	CARTES AVEC COURBES DE NIVEAU ou CARTES DE RECONNAISSANCE publiées sous forme d'esquisse planimétrique. Edition normal et provisoire de 4 à 5 couleurs.
1/250,000	CARTES ROUTIERES DU VIETNAM - 7 couleurs 9 feuilles. Feuille simple et Feuille pliee avec couverture.
1/400,000	CAO-NGUYEN MIEN NAM (Hauts-plateaux du Sud-Vietnam) - 4 couleurs - 2 coupures.
1/500,000	CARTES ADMINISTRATIVES et ROUTIERES DU VIETNAM - de 8 à 10 couleurs - 8 feuilles.
1/500,000	CARTE ADMINISTRATIVE DU SUD-VIETNAM (carte scolaire) - 7 couleurs - 4 coupures.
1/1,000,000	Carte pédologique du Viet-Nam.
1/1,750,000	VIETNAM TONG-QUAT (carte générale du Viet-Nam) - 5 couleurs.
1/2,000,000	BAN-DO VIET-NAM (croquis physique et routier) - 8 couleurs.
1/2,000,000	VIET-NAM KINH-TE (Vietnam économique) 8 couleurs.
	INDOCHINE - CARTES GENERALES
1/400,000	CARTES ROUTIERES DE L'INDOCHINE (monochrome) - 24 feuilles.
1/500,000	Cartes geologique de l'Indochine.
1/1,000,000	CARTES AERONAUTIQUE (O.A.C.I.) - monochrome - (5 feuilles pour le VIETNAM)
1/2,000,000	CAMBODGE-LAOS-VIETNAM (Croquis physique et routier) - 9 couleurs.
1/2,000,000	INDOCHINE ECONOMIQUE - 8 couleurs.
1/2,000,000	INDOCHINE GEOLOGIQUE - 15 couleurs - 2 coupures.
1/4,000,000	CARTE DE L'INDOCHINE (en relief) - monochrome - format 60 cm x 45 cm.
1/7,600,000	CARTE DE L'INDOCHINE (carte d'étude) 3 couleurs - format 25 cm x 17 cm.
	CARTES LOCALES
1/20,000	Plao Sieng, 1 coupure

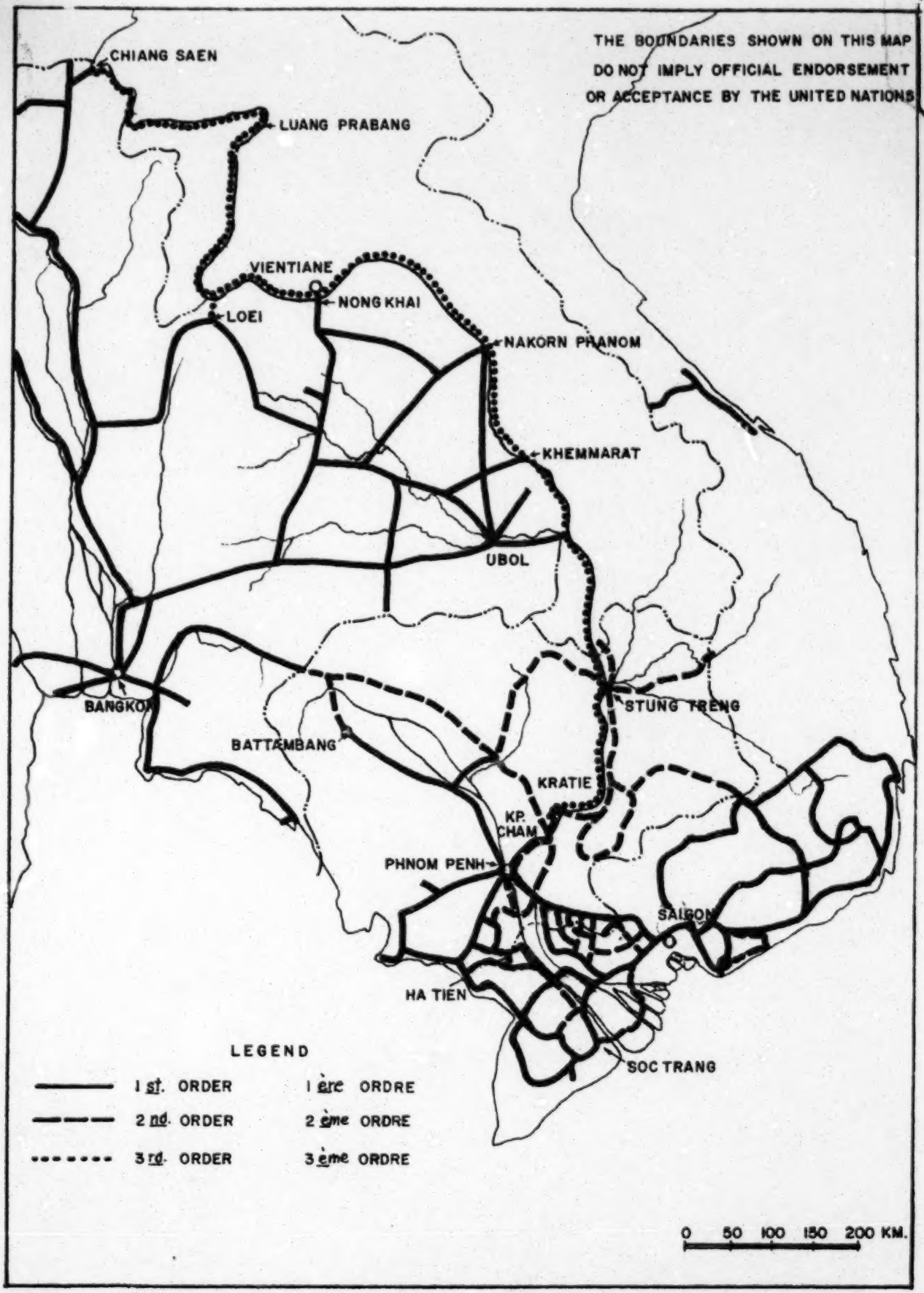

FIG. 1 NETWORK OF LEVELLING : RESEAU DE NIVELLEMENT

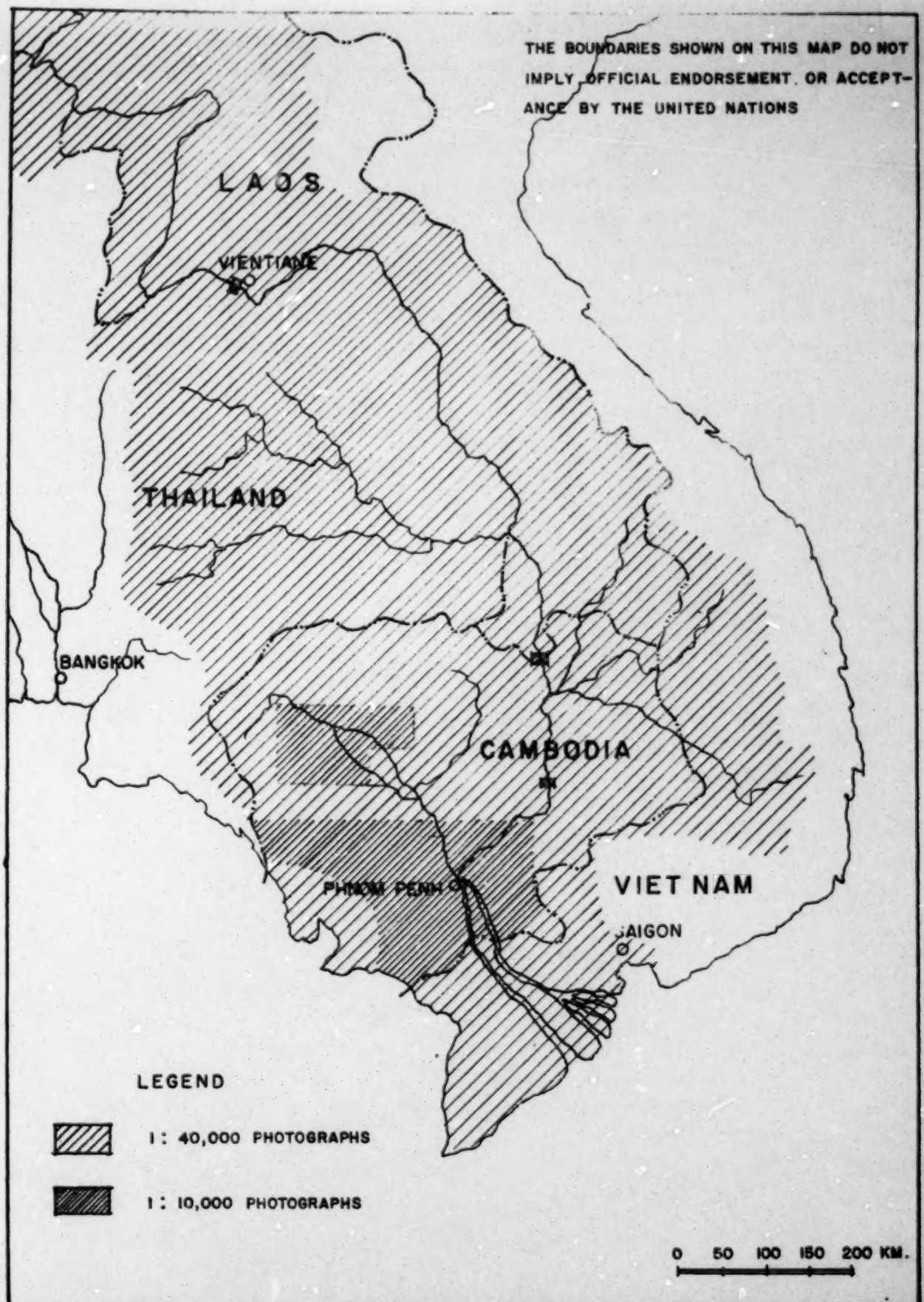

FIG. 2 AERIAL PHOTOGRAPHIC COVERAGE: COUVERTURE PHOTOGRAPHIQUE AÉRIENNE

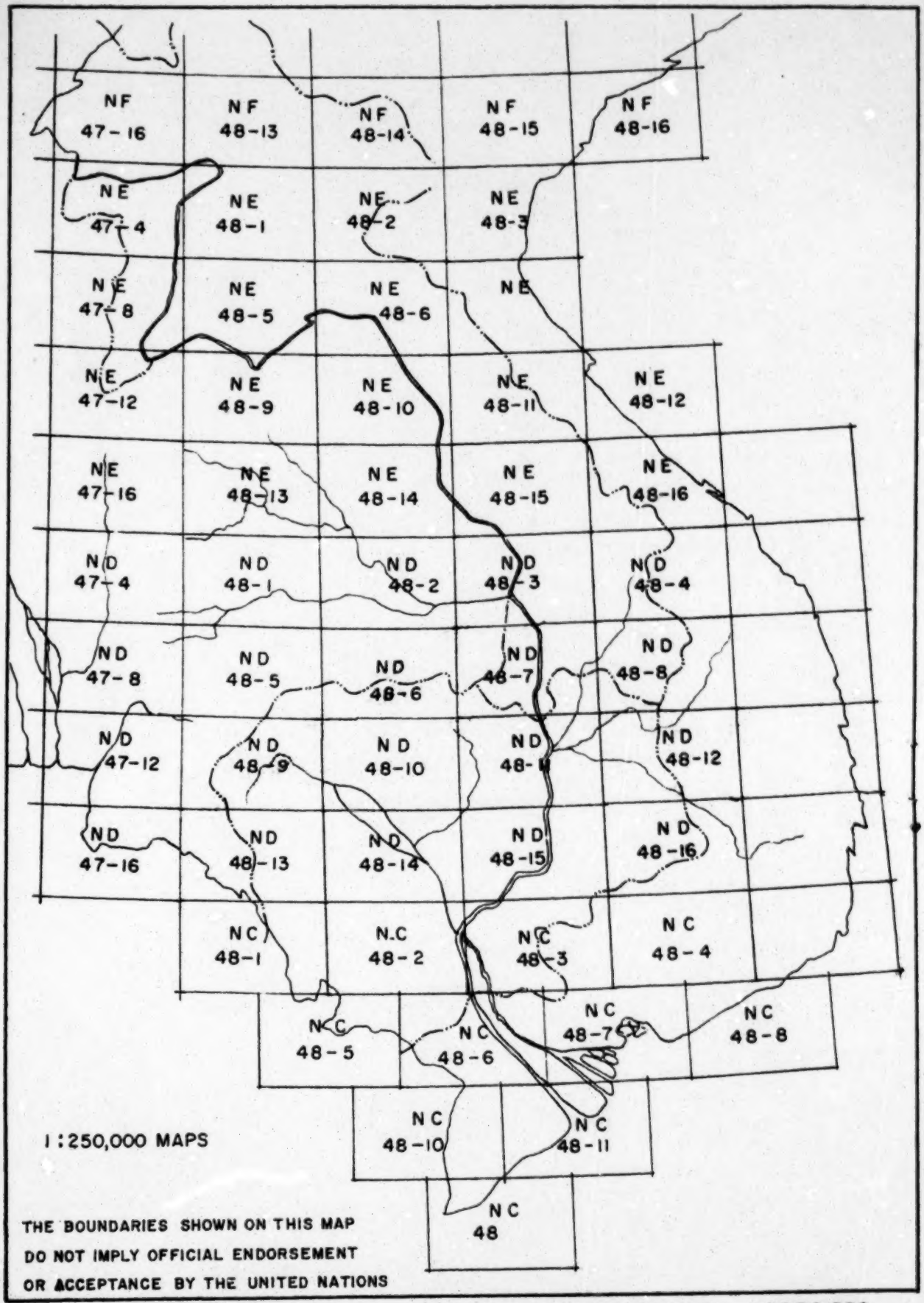

FIG. 3 TOPOGRAPHIC MAPS : CARTE TOPOGRAPHIQUE 1/250,000

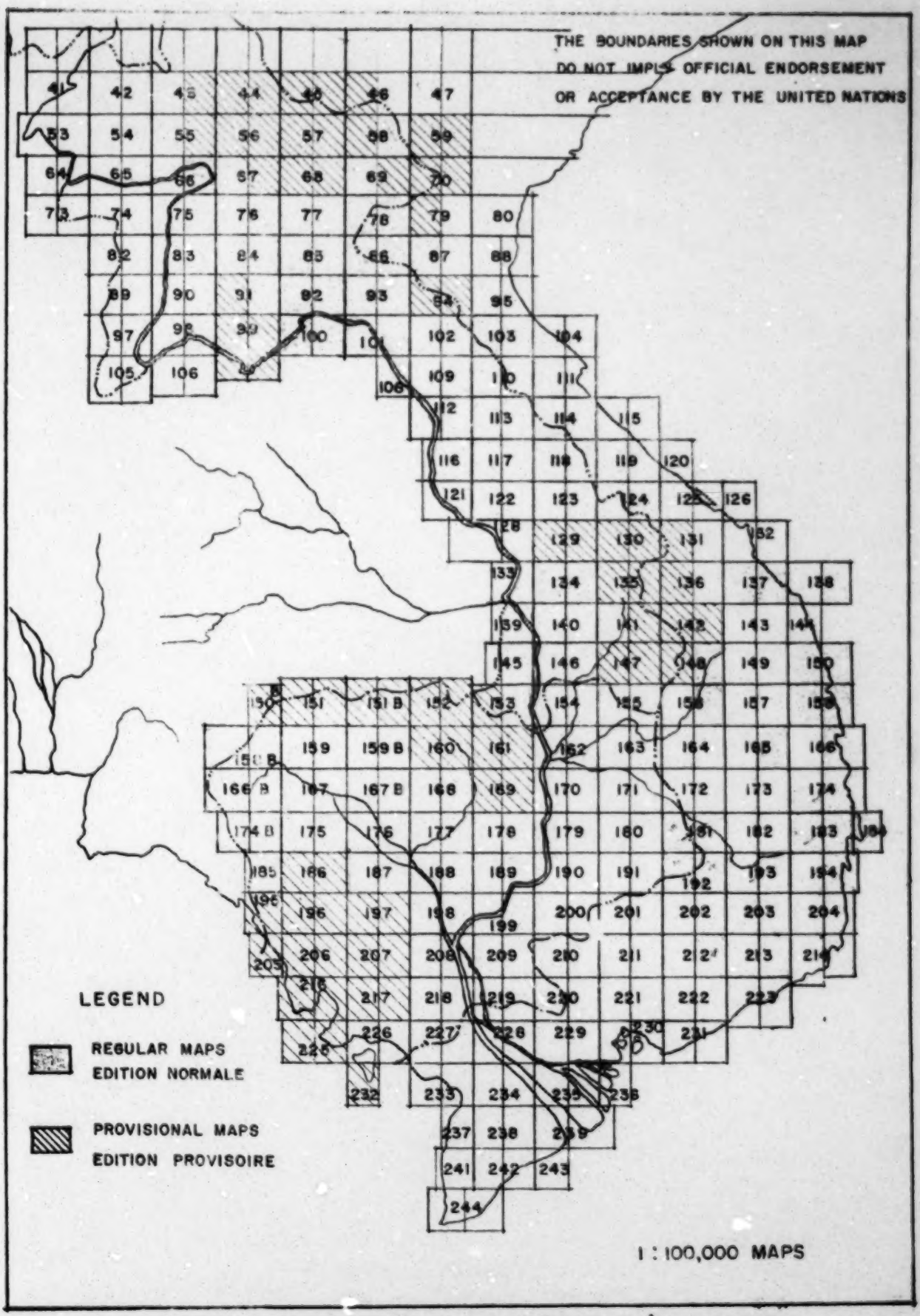

FIG. 4 TOPOGRAPHIC MAPS OF INDOCHINA : CARTE DE L'INDOCHINE

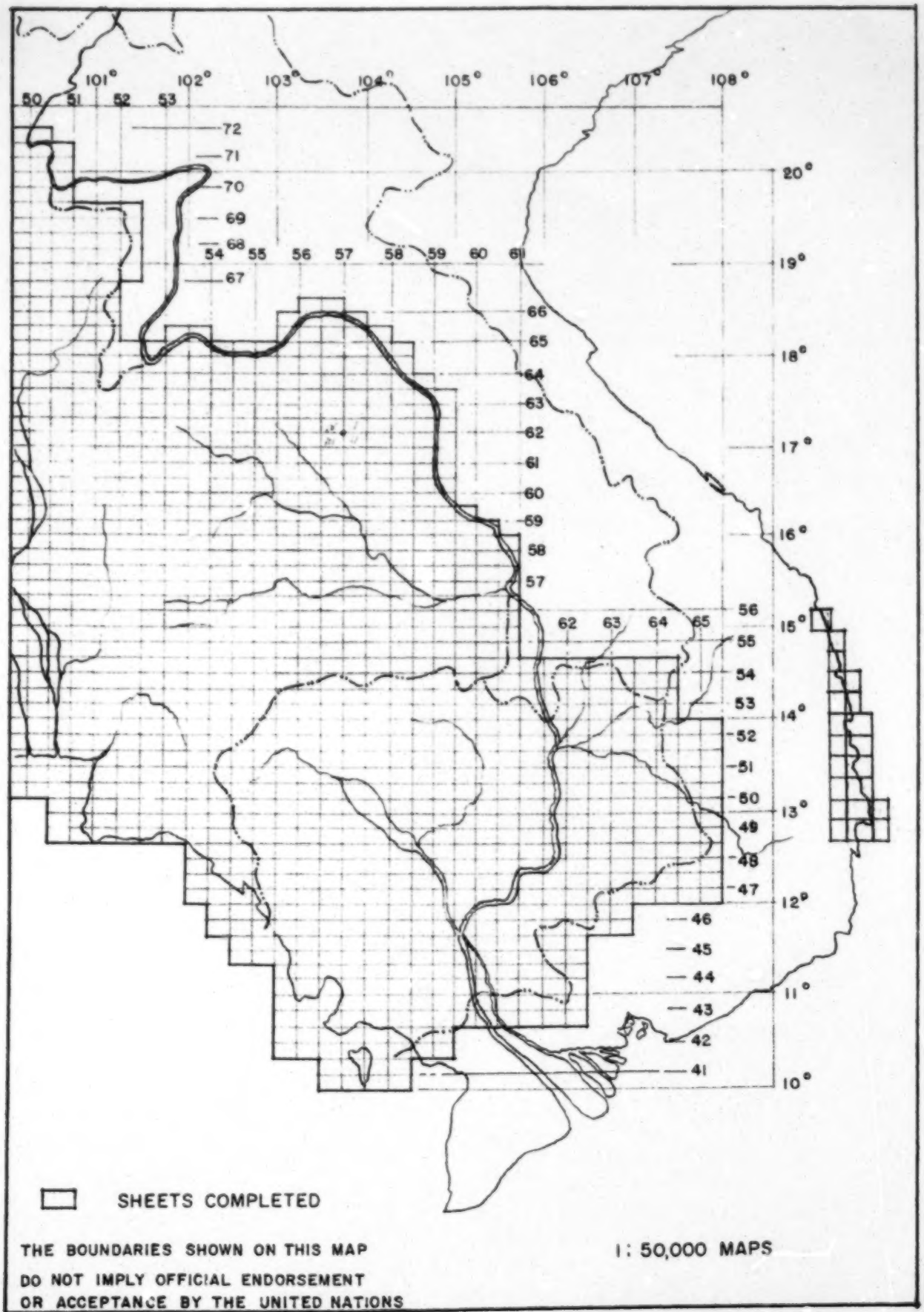

FIG. 5 TOPOGRAPHI MAPS NEW SERIES : CARTE TOPOGRAPHIQUE

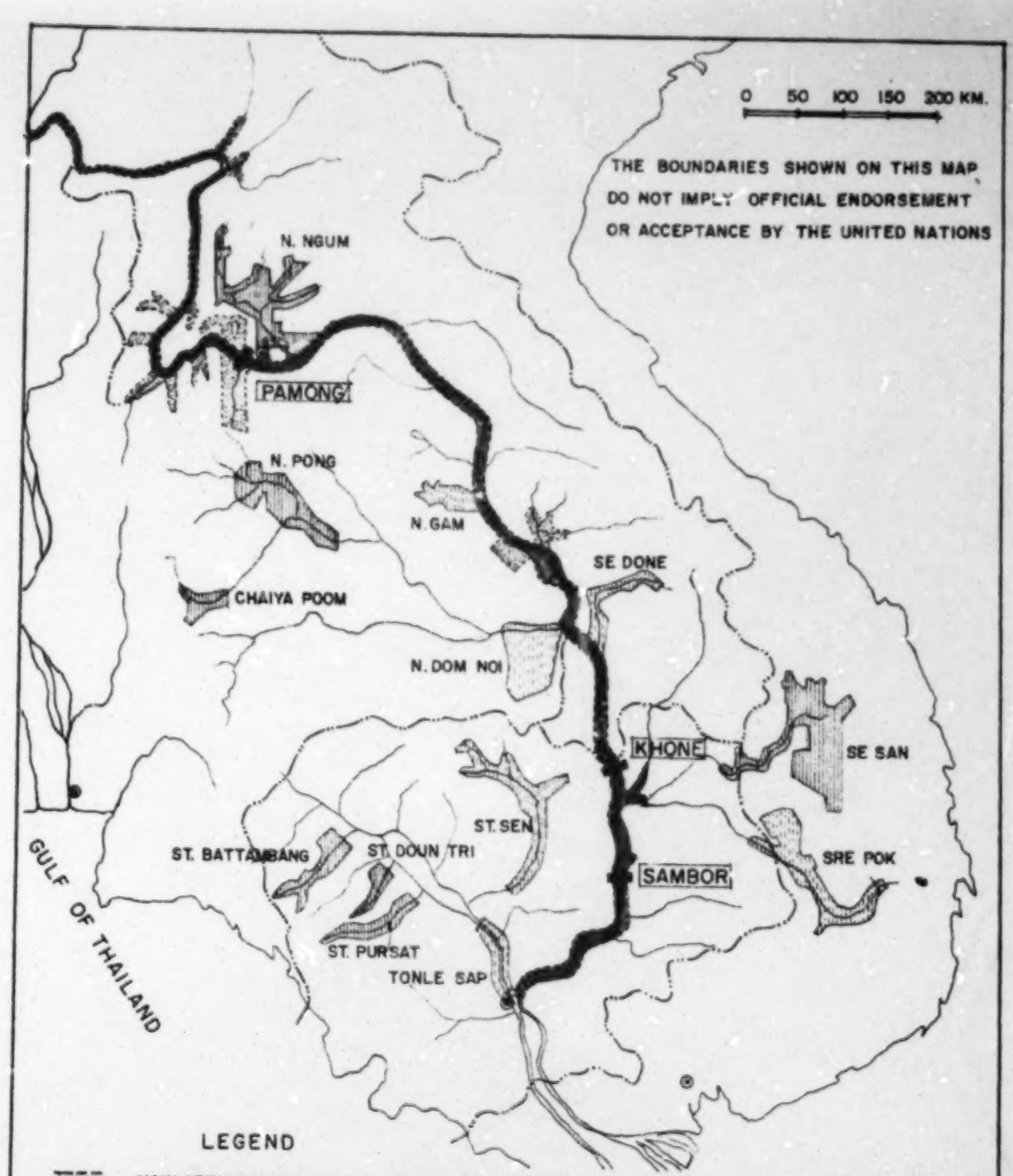
0 50 100 150 200 KM.
THE BOUNDARIES SHOWN ON THIS MAP DO NOT IMPLY OFFICIAL ENDORSEMENT OR ACCEPTANCE BY THE UNITED NATIONS
N. NGUM
PAMONG
N. PONG
N. GAM
SE DONE
CHAIYA POOM
N. DOM NOI
KHONE
SE SAN
ST. SEN
ST. BATTAMBANG
ST. DOUN TRI
SAMBOR
SRE POK
GULF OF THAILAND
ST. PURSAT
TONLE SAP
LEGEND
MAIN STEM MAPPING, GROUND CONTROLLED
CARTES DU COURS PRINCIPAL, CONTROLE AU SOL
MAIN STEM MAPPING, APR. CONTROLLED
CARTES DU COURS PRINCIPAL, CONTROLE AERIE
TRIBUTARY MAPPING, 1st. PRIORITY
CARTES DES AFFLUENTS, 1ère PRIORITE
TRIBUTARY MAPPING, 2nd PRIORITY
CARTES DES AFFLUENTS, 2ème PRIORITE
DAM SITE MAPPING, LARGE SCALE
CARTES DES SITES DE BARRAGES, A GRANDE - ECHELLE
1 : 20,000 MAIN STEM AND TRIBUTARIES.
1/20,000 COURS PRINCIPAL ET AFFLUENTS
1 : 2,000 DAM SITES
1/ 2,000 SITES DE BARRAGES

FIG. 6 TOPOGRAPHIC MAPPING BY CANADA: CARTES TOPOGRAPHIQUES EXECUTEES PAR LE CANADA

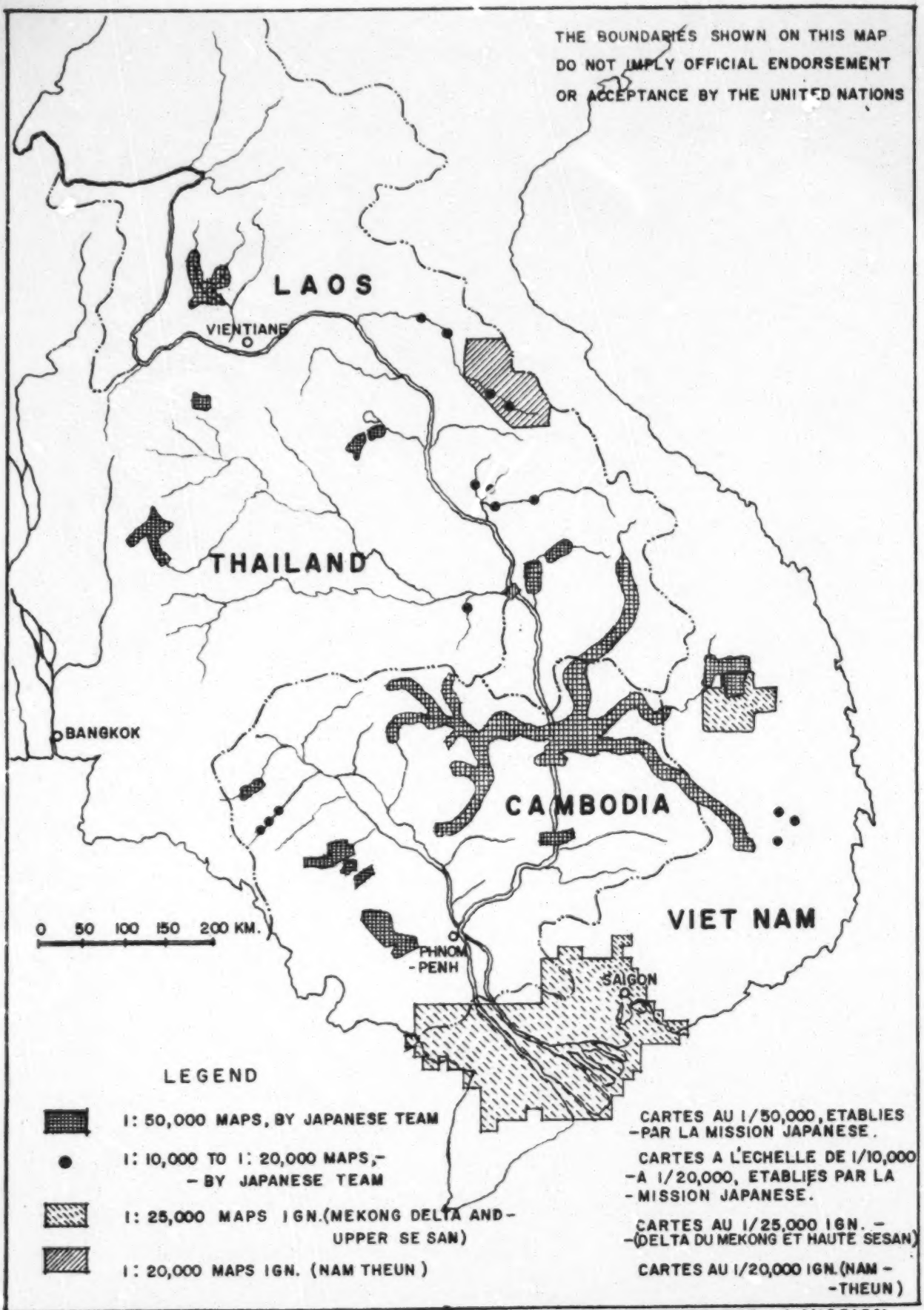
THE BOUNDARIES SHOWN ON THIS MAP
DO NOT IMPLY OFFICIAL ENDORSEMENT
OR ACCEPTANCE BY THE UNITED NATIONS
LAOS
VIENTIANE
THAILAND
BANGKOK
CAMBODIA
VIET NAM
PHNOM-PENH
SAIGON
0 50 100 150 200 KM.
LEGEND
1: 50,000 MAPS, BY JAPANESE TEAM
1: 10,000 TO 1: 20,000 MAPS, - BY JAPANESE TEAM
1: 25,000 MAPS IGN. (MEKONG DELTA AND UPPER SE SAN)
1: 20,000 MAPS IGN. (NAM THEUN)
CARTES AU 1/50,000, ETABLIES PAR LA MISSION JAPANESE.
CARTES A L'ECHELLE DE 1/10,000 A 1/20,000, ETABLIES PAR LA MISSION JAPANESE.
CARTES AU 1/25,000 IGN. (DELTA DU MEKONG ET HAUTE SESAN)
CARTES AU 1/20,000 IGN. (NAM-THEUN)

FIG.7 MAPS PREPARED BY JAPANESE TEAM AND OTHER MAPS : CARTES ETABLIES PAR LA MISSION JAPANESE ET AUTRES CARTES.